

1 CLAIMS

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3 1. A method comprising:

4 receiving a request to be transmitted over a network to a particular client
5 device;

6 determining an available downstream bandwidth that is associated with the
7 client device;

8 determining an available upstream bandwidth that is associated with the
9 client device, the available upstream bandwidth being different than the available
10 downstream bandwidth;

11 determining a request data size associated with the request;

12 determining an estimated response data size associated with the request;
13 and

14 in an event that the available downstream bandwidth is greater than the
15 request data size and the available upstream bandwidth is greater than the
16 estimated response data size, transmitting the request to the client device.

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18 2. The method as recited in claim 1 wherein the client device comprises
19 a television set-top box.

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21 3. The method as recited in claim 1 wherein the network comprises a
22 cable television network.

1 4. The method as recited in claim 1 wherein the available upstream
2 bandwidth is less than the available downstream bandwidth.

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4 5. The method as recited in claim 1 wherein the available upstream
5 bandwidth is configurable.

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7 6. The method as recited in claim 1 wherein the available upstream
8 bandwidth is configurable to vary over time.

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10 7. The method as recited in claim 1 wherein the available downstream
11 bandwidth is configurable.

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13 8. The method as recited in claim 1 wherein the available downstream
14 bandwidth is configurable to vary over time.

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16 9. A cable television system headend configured to perform the method
17 as recited in claim 1.

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19 10. One or more computer-readable media comprising computer-
20 executable instructions that direct a computing system to perform the method as
21 recited in claim 1.

1 11. A method comprising:

2 receiving a request to be transmitted over a downstream network path to a
3 particular client device, the client device configured to transmit a response over an
4 upstream network path;

5 identifying one or more other client devices that contend for the upstream
6 network path; and

7 in an event that there are no outstanding requests to any of the one or more
8 other client devices, transmitting the request to the particular client device.

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10 12. The method as recited in claim 11 wherein an available bandwidth
11 on the upstream network path differs from an available bandwidth on the
12 downstream network path.

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14 13. The method as recited in claim 11 wherein the client device
15 comprises a television set-top box.

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17 14. The method as recited in claim 11 wherein the downstream network
18 path is part of a cable television network.

1 15. The method as recited in claim 11 further comprising:
2 determining a maximum number of contending client devices associated
3 with the upstream network path to which outstanding requests may be pending;
4 receiving a second request to be transmitted over the downstream network
5 path to a second client device, the second client device configured to transmit a
6 response to the second request over the upstream network path;
7 determining a number of other client devices associated with the upstream
8 network path to which pending requests are outstanding; and
9 in an event that the number of other client devices to which pending
10 requests are outstanding is less than the maximum number of contending client
11 devices to which outstanding requests may be pending, transmitting the second
12 request to the second client device.

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14 16. One or more computer-readable media comprising computer-
15 executable instructions that direct a computing system to perform the method as
16 recited in claim 11.

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1 17. A method comprising:

2 receiving a request to be transmitted over a network to a particular client

3 device; and

4 placing the request in a request queue, the request queue being associated
5 with an upstream network channel over which a response to the request may be
6 received from the client device.

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8 18. The method as recited in claim 17 further comprising:

9 transferring the request from the request queue to a dispatch queue when an
10 available downstream network bandwidth is sufficient to accommodate the request
11 and an available upstream network bandwidth is sufficient to accommodate an
12 anticipated response to the request.

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14 19. One or more computer-readable media comprising computer-
15 executable instructions that direct a computing system to perform the method as
16 recited in claim 17.

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1 20. A method comprising:

2 identifying a plurality of upstream network paths associated with a single

3 downstream network path;

4 establishing a plurality of application request queues, wherein first and
5 second application request queues of the plurality of application request queues
6 are associated with first and second upstream network paths of the plurality of
7 upstream network paths, respectively;

8 receiving first and second requests to be transmitted to first and second
9 client devices, respectively;

10 determining that the first client device is associated with the first upstream
11 network path and that the second client device is associated with the second
12 upstream network path;

13 storing the first request in the first application request queue and storing the
14 second request in the second application request queue; and

15 performing a scheduling process, the scheduling process comprising:

16 verifying that a bandwidth available on the downstream network
17 path is larger than the first request;

18 verifying that a bandwidth available on the first upstream network
19 path is larger than an anticipated response to the first request; and

20 moving the first request to a first dispatch queue.

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21. The method as recited in claim 20 wherein the scheduling process further comprises:

verifying that the bandwidth available on the downstream network path is larger than the first request and the second request combined;

verifying that a bandwidth available on the second upstream network path is larger than an anticipated response to the second request; and

moving the second request to a second dispatch queue.

22. The method as recited in claim 21 further comprising:

transmitting the first and second requests from the first and second dispatch queues over the downstream network path.

23. A method comprising:

establishing an application request channel; assigning to the application request channel a portion of an available downstream bandwidth; and

associating an application with the application request channel such that a request initiated by the application can only be transmitted when the portion of the available downstream bandwidth is large enough to accommodate the request.

24. The method as recited in claim 23 wherein the portion of the available downstream bandwidth comprises 100 percent of the available downstream bandwidth

1 25. The method as recited in claim 23 further comprising:

2 assigning to the application request channel a portion of an available
3 upstream bandwidth such that the request initiated by the application can only be
4 transmitted when the portion of the available upstream bandwidth is large enough
5 to accommodate an anticipated response to the request.

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7 26. The method as recited in claim 23 wherein the portion of the
8 available upstream bandwidth comprises 100 percent of the available upstream
9 bandwidth.

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11 27. One or more computer-readable media comprising computer-
12 executable instructions that direct a computing system to perform the method as
13 recited in claim 23.

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15 28. A method comprising:

16 establishing an application request channel;
17 assigning to the application request channel a portion of an available
18 upstream bandwidth; and

19 associating an application with the application request channel such that a
20 request initiated by the application can only be transmitted when the portion of the
21 available upstream bandwidth is large enough to accommodate an anticipated
22 response to the request.

1 29. The method as recited in claim 28 wherein the portion of the
2 available upstream bandwidth comprises 100 percent of the available upstream
3 bandwidth.

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5 30. The method as recited in claim 28 further comprising:
6 assigning to the application request channel a portion of an available
7 downstream bandwidth such that the request initiated by the application can only
8 be transmitted when the portion of the available downstream bandwidth is large
9 enough to accommodate the request.

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11 31. The method as recited in claim 28 wherein the portion of the
12 available downstream bandwidth comprises 100 percent of the available
13 downstream bandwidth.

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15 32. One or more computer-readable media comprising computer-
16 executable instructions that direct a computing system to perform the method as
17 recited in claim 28.

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1 33. A system comprising:

2 an application request queue for receiving requests to be transmitted to
3 client devices via a downstream network path;

4 a plurality of upstream request queues for grouping the requests based on
5 upstream network paths over which responses to the requests may be received; and

6 a bandwidth management system configured to schedule requests from the
7 plurality of upstream request queues for transmission to the client devices based,
8 at least in part, on available bandwidth associated with one or more of the
9 upstream network paths.

10 34. The system as recited in claim 33 wherein the bandwidth
11 management system is further configured to schedule the requests from the
12 plurality of upstream request queues for transmission to the client devices based
13 on available bandwidth associated with the downstream network path.

14 35. The system as recited in claim 33, implemented as a component of a
15 cable television system headend.

1 36. A system comprising:

2 one or more application request channels for receiving requests to be
3 transmitted to client devices via a downstream network path, individual ones of
4 the application request channels having an associated downstream path bandwidth
5 allocation;

6 a plurality of upstream request queues for grouping the requests based on
7 upstream network paths over which responses to the requests may be received; and

8 a bandwidth management system configured to schedule requests from the
9 plurality of upstream request queues for transmission to the client devices based,
10 at least in part, on a request size and the downstream path bandwidth allocation
11 associated with the application request channel through which the request was
12 received.

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14 37. The system as recited in claim 36 wherein individual ones of the
15 application request channels have an associated upstream path bandwidth
16 allocation and wherein the bandwidth management system is further configured to
17 schedule requests from the plurality of upstream request queues based on an
18 estimated response size and the upstream path bandwidth allocation associated
19 with the application request channel through which the request was received.

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21 38. The system as recited in claim 36, implemented as a component of a
22 cable television system headend.

1 39. A system comprising:

2 one or more application request channels for receiving requests to be
3 transmitted to client devices via a downstream network path, individual ones of
4 the application request channels having an associated upstream path bandwidth
5 allocation;

6 a plurality of upstream request queues for grouping the requests based on
7 upstream network paths over which responses to the requests may be received; and

8 a bandwidth management system configured to schedule requests from the
9 plurality of upstream request queues for transmission to the client devices based,
10 at least in part, on an anticipated request response size and the upstream path
11 bandwidth allocation associated with the application request channel through
12 which the request was received.

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14 40. The system as recited in claim 39 wherein individual ones of the
15 application request channels have an associated downstream path bandwidth
16 allocation and wherein the bandwidth management system is further configured to
17 schedule requests from the plurality of upstream request queues based on a request
18 size and the downstream path bandwidth allocation associated with the application
19 request channel through which the request was received.

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21 41. The system as recited in claim 39, implemented as a component of a
22 cable television system headend.

1 42. A system, comprising:

2 means for receiving a request from an application, the request to be
3 transmitted to a particular client device;

4 means for queuing the request based on an upstream network path over
5 which a response to the request may be received; and

6 means for scheduling transmission of the request based, at least in part, on
7 an available upstream network bandwidth.

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9 43. The system as recited in claim 42 wherein the means for scheduling
10 further comprises means for scheduling transmission of the request based, at least
11 in part, on an available downstream network bandwidth.

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13 44. The system as recited in claim 42 wherein the means for scheduling
14 further comprises means for scheduling transmission of the request based, at least
15 in part, on a number of pending requests previously transmitted to other client
16 devices associated with the upstream network path.

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18 45. The system as recited in claim 42 further comprising means for
19 estimating an anticipated response size.

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1 46. One or more computer-readable media comprising computer-
2 executable instructions that, when executed, direct a computing system to:

3 receive a request;
4 identify an upstream network path associated with the request;
5 queue the request based on the upstream network path; and
6 schedule the request for transmission based on an available bandwidth
7 associated with the upstream network path.

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9 47. One or more computer-readable media comprising computer-
10 executable instructions that, when executed, direct a computing system to:

11 receive a request;
12 identify a client device to which the request is to be transmitted;
13 identify an upstream network path associated with the client device;
14 identify one or more other client devices that are associated with the
15 upstream network path;
16 queue the request based on the upstream network path; and
17 schedule the request for transmission based on a number of the one or more
18 other client devices to which pending requests have been transmitted.

1 48. One or more computer-readable media comprising computer-
2 executable instructions that, when executed, direct a computing system to:

3 receive a request through an application request channel;
4 identify a client device to which the request is to be transmitted;
5 identify an upstream network path associated with the client device;
6 queue the request based on the upstream network path;
7 identify an upstream bandwidth allocation associated with the application
8 request channel; and

9 schedule the request for transmission based on a comparison between an
10 available bandwidth associated with the upstream network path, the upstream
11 bandwidth allocation, and a size of an anticipated response to the request.

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13 49. The one or more computer-readable media as recited in claim 48,
14 further comprising computer-executable instructions that, when executed, direct
15 the computer system to estimate the size of an anticipated response to the request.

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1 50. One or more computer-readable media comprising computer-
2 executable instructions that, when executed, direct a computing system to:

3 receive a request through an application request channel;
4 identify a client device to which the request is to be transmitted;
5 identify an upstream network path associated with the client device;
6 identify a downstream network path associated with the client device;
7 queue the request based on the upstream network path; and
8 identify a downstream bandwidth allocation associated with the application
9 request channel;

10 schedule the request for transmission based on a comparison between an
11 available bandwidth associated with the downstream network path, the
12 downstream bandwidth allocation, and a size of the request.

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14 51. One or more computer-readable media comprising computer-
15 executable instructions that, when executed, direct a computing system to:

16 schedule requests at a scheduling interval by placing the requests in a
17 dispatch queue, the scheduling interval defined by a particular value;

18 determine a number of requests in the dispatch queue; and
19 in an event that the number of requests in the dispatch queue is greater than
20 or equal to a maximum number of allowed pending requests, prevent requests
21 from being scheduled until the number of requests in the dispatch queue is less
22 than the maximum number of allowed pending requests.

1 52. The one or more computer-readable media as recited in claim 51,
2 wherein the particular value is configurable.

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4 53. The one or more computer-readable media as recited in claim 51,
5 wherein the maximum number of allowed pending requests is equal to an integer
6 multiple of a number of requests that can be scheduled into the dispatch queue
7 during a single scheduling interval.

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